Commercial Refrigeration Specifications Technical Working Group Meeting

April 26, 2010

California Energy Commission (CEC)
California Air Resources Board (ARB)

Meeting Outline

- Objectives
- Background
- Title 24 Standards Process
- Overview of Commercial Refrigeration Systems
- Baselines and Potential Alternatives
- Next Steps

Objectives

- Develop Title 24 Building Energy Efficiency Standards to reduce direct greenhouse gas (GHG) emissions from refrigerants, and indirect GHG emissions from energy usage
- Applies to new retail food facilities, systems
- Refrigerated warehouses – TBD. Potential for some direct emissions standards (energy standards exist)
- Invite stakeholder input and data, discuss options
- Identify resources and areas needing further analysis

Background

Background

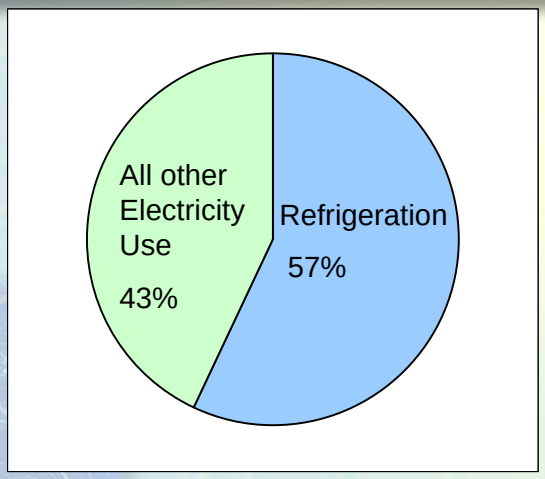
- Specifications for commercial refrigeration systems included in the Scoping Plan as an AB 32 greenhouse gas reduction measure in 2007
- Stakeholder feedback from April 2008 Workshop led to re-evaluation of approach
- Develop standards that address both direct and indirect GHG emissions
- Incorporate new standards in CA Building Standards Code (Title 24, Part 6; CEC)
- ARB funds research study on issue
- CEC is now the lead agency

Why regulate commercial refrigeration in the building code?

- Voluntary programs (e.g. Savings By Design) have been very successful – what was once best practice is now standard practice
- Continuous improvement - standard practice should be required & best practice encouraged
- Commercial refrigeration energy use in CA is huge (15,000 GWh/yr ➔ 5 Power Plants!)

Source: California Energy Commission, Electricity Demand Forecast, 2009

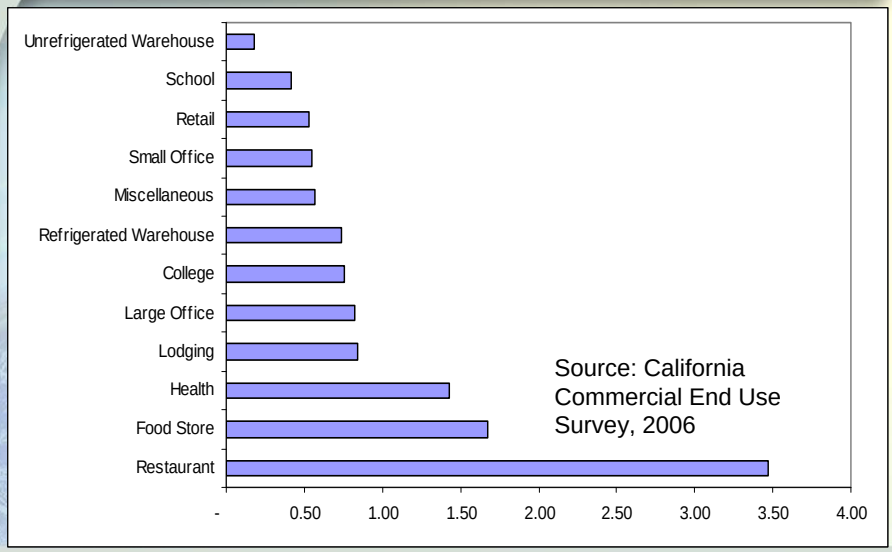
Electricity Use in Food Sales



Source: Adapted from Southern California Edison White Paper "Refrigerants and Greenhouse Gases" Dec 2008

Energy Intensity by Building Type

therms/ft^2



Title 24 Building Energy Efficiency Standards Process

Title 24 Process

Energy Code Components

- Mandatory Requirements
  - Appropriate for all applications
- Prescriptive Requirements
  - Appropriate for specific applications
  - Establishes basis for the Performance Path
  - Mandatory & Prescriptive Baseline ➔ Minimum levels of Efficiency

Title 24 Process

Energy Code Components

Performance Path to Code Compliance

- Model-based approach to allow flexibility in efficiency options
- Compared to the Prescriptive Baseline
- Modeling rules established for each efficiency measure
- Requires energy simulation software approved by the CEC for code compliance

Commercial Refrigeration Standards Development

- Leverage data and results from Savings By Design Program & Refrigerated Warehouse Standards development
- Use existing Title 20 Appliance Standards where possible (walk-in coolers, etc.)
- Involve industry to develop recommendations that are effective and enforceable
- Establish evaluation framework for direct and indirect emissions ➔ Time Dependent Valuation of Energy Costs that account for Cost of Carbon

Tentative Schedule of 2011 Update

Now – August 2010	Updates to weather data, time dependent valuation, life cycle cost methodology Scoping of update recommendations – separate studies sponsored by utilities, industry, ARB (commercial refrigeration)
August 2010 - February 2011	Assess energy savings, emission reductions and cost-effectiveness of update recommendations Draft code language for update recommendations
June 2010	Webinar meeting – review baseline, energy conservation measures to be modeled
September 2010	2nd Commercial Refrigeration Working Group Meeting – review analysis
January 2011	3rd Commercial Refrigeration Working Group Meeting – review code language
February 2011	Drafting Standards and Rulemaking documents
Feb. to July 2011	Rule-making activities
June 2011	Adopt Standards (to be implemented January 1, 2013)

Overview of Commercial Refrigeration Systems



Refrigerant Emissions - Context

- **Small amounts of refrigerant leaked cause large greenhouse gas emissions:**

  1 pound R-404A

  = 1.5 metric tonnes CO_2 equivalent ($MTCO_2E$)

  = 2,000 kWh

  = Household electricity for two months

  = 160 gallons of gasoline consumed

Source: U.S. EPA Greenhouse Gas Equivalencies Calculator

Refrigeration System Emissions

- **Commercial Refrigeration Emissions Sources**
  - Direct refrigerant emissions occur from system leaks, ruptures, installation, maintenance, and end-of life (EOL)
  - Indirect emissions (CO_2E emissions resulting from energy use) occur during equipment operation
  - Typical Supermarket CO_2E impact:

    2/3 from refrigerant leaks, 1/3 energy usage

Annual Emissions Impacts

- Direct emissions in CA: at 18% annual leak rate, 11 million lbs/yr (12.2 $MMTCO_2E$)
- Indirect emissions add another 5-6 $MMTCO_2E$ annually (est.)
- 17-18 $MMTCO_2E$ emissions total each year, =

40 million barrels of oil

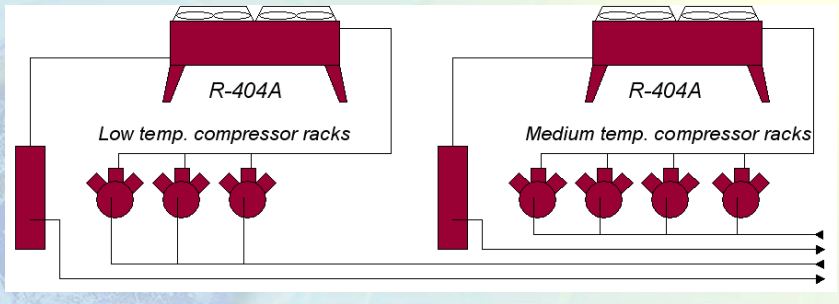
Or

Electricity used by 2 million homes/year

Sources: ARB Refrigerant Management Plan Emissions Analysis 2009; Southern California Edison White Paper "Refrigerants and Greenhouse Gases" Dec 2008; U.S. EPA Greenhouse Gas Equivalencies Calculator

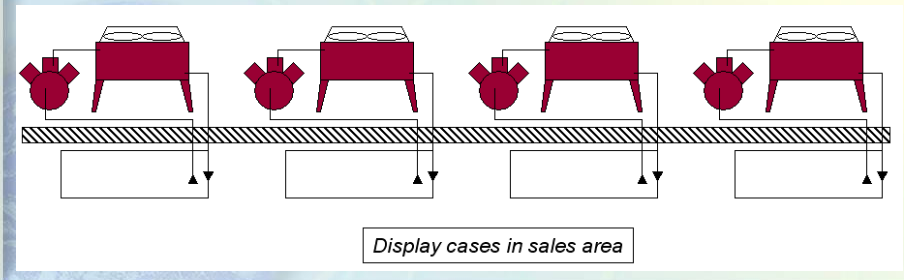
Refrigeration System Types

- **Direct Expansion (DX) – multiplex or single compressor**
  - **Common in retail food facilities**
  - **Large refrigerant charge, many feet of piping**



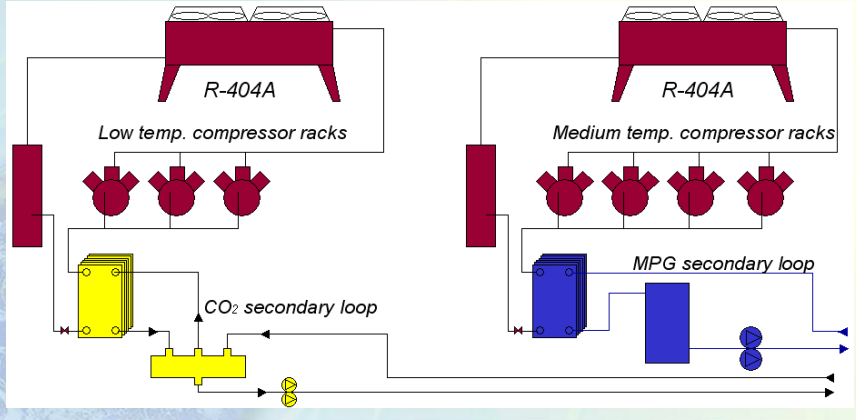
Refrigeration System Types

- **Distributed Systems**
  - uses an array of distributed compressor racks located near refrigerated cases
  - reduces refrigerant piping 40-70%



Refrigeration System Types

- **Secondary Loop uses a chiller to cool a heat transfer fluid – reduces refrigerant charge 85%**



Baselines and Potential Alternatives

Developing a Baseline

- Baseline assumptions will have to developed that represent design and operating factors such as:
  - Type of refrigeration system (DX, Distributed, Secondary Loop)
  - Type of equipment used
  - Type of refrigerant (R-404A)
  - Refrigerant charge size
  - Refrigerant leak rates
  - Other parameters
- Energy conservation measures will be applied to and modeled on selected baseline systems

Energy Efficiency Modeling

Energy efficiency upgrades will be modeled on baseline systems

Examples of Energy Conservation Measures (ECMs) to model include:

- Occupancy sensors for lighting in display cases
- Demand defrost
- Variable speed compressors, fans
- Anti-sweat heater controls
- Triple-pane glass
- Replace open door cases with closed-door cases
- Many other ECMs

Leak Reduction Measures

- Leak reduction measures will be identified & analyzed to screen out measures that are not cost-effective
- Measures focus on design & installation
  - Best practices
  - High quality components
- Preliminary sources:
  - ANSI/ASHRAE Standard 147-2002
  - ANSI/ASHRAE 15-2007
  - ANSI/IIAR 2-2008
  - GreenChill Best Practices

Balancing Energy Use and Refrigeration Options

- Trade-off Issue: Conflict between goals of energy-efficiency and reduced refrigerant charge size/leakage
- The study will assess these trade-offs by standardizing direct & indirect emissions (CO_2E) and proposing standards to ensure a reduction in overall GHG impacts
  - Indirect GHG impacts will be assessed using the EnergyPlus model
  - Direct GHG impacts will be assessed offline based on estimated annual refrigerant losses & GWP-weighting; will be layered over EnergyPlus results
  - Results will be integrated to provide a "common denominator" (in $MTCO_2E$) to compare different systems equitably

Next Steps – Baseline Development and Modeling Efforts

Next Steps

- Confirm & prioritize baseline characteristics
- Confirm & prioritize ECMs to be assessed
- Define magnitude of changes in leak rate and charge size impacts associated with certain ECMs
- Model energy requirements of baseline and alternative baselines with ECMs in different climate zones

Next Steps (cont.)

- Model direct emissions and costs based on refrigerant emissions/costs
- Conduct research on costs of baseline system, alternative baseline systems, ECMs, leak reduction measures
- Technical Work Group webinar June 2010 to discuss baseline, ECM assumptions
- Work Group to meet two more times – September 2010 and January 2011 proposed

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